Self Sensing Composites: an added value for the complete life cycle of composite structures

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Abstract

It was announced by the EWEA (European wind energy association) that key areas for wind energy research should focus on :

- Increasing the reliability, accessibility and efficiency of wind turbines
- Optimizing the maintenance and installation of offshore turbines and their substructures
- Improving the design and layout of wind farms
- Demonstrating large wind turbine prototypes and large, interconnected offshore wind farms
- New methods of grid management to allow high levels of wind power in the system
- Expansion of education schemes and better training facilities

We believe that the envisaged results of the SBO-project the 'self sensing composites' (2013 – 2016, IWT-contract 120024), we can offeradded value in the first two key areas summarized above. Reliability and efficiency increase can only be reached when a thorough knowledge exists of the fabrication process together with redesigns of currently existing wind turbine blades using their online loading information. Optimizing maintenance planning and maintenance procedures should definitely be supported by online measurement techniques which are able to determine the integrity of the blade. If a life time extension is possible by having the knowledge through in-situ monitoring this will definitely increase the efficiency of the blades in terms of investment cost. In this scenario, the wind energy industry could switch from reactive maintenance (run-to-failure) and preventive maintenance (following the wind turbine manufacturer's manual) to maintenance.

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In this presentation, the current progress in the SSC-project on the online monitoring of the cure degree of composites during production is shown. Two strategies are followed, firstly, the embedding of a deformable network of capacitances in the composite material, which can later on be used to sense the ageing effects of composites in operation, and secondly, the installation of a network of capacitances in the mould of the composite part. However, measuring only the cure-degree during the production cycle is however not sufficient to fully define the initial state of a composite part, and therefore these sensor networks will be combined with measurements using embedded optical fibres. Defining the onset of residual strain build-up is in this matter seen as a key factor.

At the end of the presentation, some applications in which sensor networks are becoming reality are shown.

Keywords: Composites, Sensors, Cure cycle monitoring, Strain monitoring